GUINEA FOWL FERTILITY, HATCHABILITY AND EMBRYONIC MORTALITY IN AN INTENSIVELY MANAGED FARM IN ASHANTI REGION OF GHANA

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ABSTRACT

A study was conducted to investigate the reproductive performance of Guinea fowls on a commercial farm in the Ashanti region of Ghana. This study reported for the first time in Ghana, the reproductive performance of Guinea fowls reared under an intensive production system. The birds were intensively reared on deep litter with a mating ratio of one male to ten females for the production of day-old keets. Eggs were collected daily and stored for seven days at temperatures between 16 – 20º Celsius and selected for incubation in an automated Petersime incubator. Data on incubated Guinea fowl eggs for the period 2011 – 2018 were obtained from the hatchery unit records and analyzed using Graph Pad Prism version 5.00 for Windows. The percentage overall fertility, total hatchability, fertile hatchability, embryonic mortality, viable keets and non-viable keets were 50.7 ± 13, 30.5 ± 14, 50.4 ± 15, 22 ± 10, 91.7 ± 5.4 and 8.3 ± 6.3 % respectively. Fertility and fertility hatchability were low on this farm, while embryonic mortality was high. The study recommends a change in the mating ratio to one male Guinea fowl to four females, improvement of hygienic conditions in egg processing, regular fumigation of the farm and improved incubator management.

Keywords: Guinea fowl, Fertility, Hatchability, Embryonic mortality, Ghana

INTRODUCTION

Guinea fowls are believed to have originated from the Guinea Coast of West Africa and are descendants of the helmeted Guinea fowl (*Numida meleagris* Linnaeus 1758) (Awotwi, 1987). Guinea fowls are popular due to the nature of their meat and are now in high demand throughout the world. Guinea fowls are reared mainly in the Northern part of Ghana under an extensive and semi-intensive system (Dei and Karbo, 2004) and intensively on some farms in Southern Ghana (Annor *et al*., 2012). The eggs are incubated using laying hens as foster parents or commercially available small capacity incubators. The major varieties of Guinea fowls reared in Ghana include, lavender, pearl and white coloured birds (Teye *et al*., 2008).

Akate Farms, located in the Kwabre district of the Ashanti region, have intensively commercialized Guinea fowl production since 2011. It produces day-old Guinea keets for sale to the general public. The commercialization of Guinea fowl production in Africa is faced with challenges such as inadequate nutrition, poor housing, high keet mortality, lack of health control and inadequate technical support from government extension services (Moreki and Radikara, 2013).

Other constraints to intensive Guinea fowl production include low fertility and hatchability of the eggs (Nwagu and Alawu, 1995; Issaka and Yeboah, 2016).

Little information is available on the reproductive performance of indigenous Guinea fowls raised under intensive production in Ghana. The purpose of this study was therefore to investigate reproductive performance of Guinea fowls raised intensively.

MATERIALS AND METHODS

Location and Duration of Study: The study was conducted at the Guinea Fowl Section of Akate Farms located at Bosore in the Kwabre District of Ashanti region, Ghana from January to March, 2019. The area is located in the semi-deciduous forest zone of Ghana between latitude $06^{0}45^{1}$N and longitude $01^{0}33^{1}$W (GSS, 2012).

Source and Management: The original parent stock was obtained by hatching Guinea fowl eggs purchased from Northern Ghana. Akate farms maintain a breeding stock of averagely 30,000 birds, housed on a deep litter system with a mating ratio of one male to ten females. Successive generations of birds have been maintained on this farm for production of day old keets, since 2011.

The birds were given Vitalite and glucose in water on the first day of life. Vaccination against Newcastle disease was done at two weeks, six weeks and sixteen weeks old respectively, while Gumboro vaccine was given at three weeks old. Antibiotics, vitamins and coccidiostats were given when necessary.

Egg laying commenced in February annually and continued up to October, while egg incubation was done from February to October yearly. The adult parent stock was fed with 126 – 144 g feed per bird daily with a chicken mash containing 17.1 % crude protein and 2576 kcal/kg metabolisable energy. The ingredients were purchased from Agricare Ghana Limited, Kumasi, Ghana.

Eggs were collected three or four times daily from wooden nest, sorted and stored for a maximum of seven days under storage temperature between 16 – 20^{0}C and selected for incubation based on egg quality and size. The selected eggs were sent to an automated Petersime incubator in batches. Averagely two incubations were made per month based on management decision. Temperature and relative humidity were maintained at 37.5 ± 0.5° C and 74 – 85 % at setting and 36.5 ± 0.5° C and 66 – 75 % at hatching. Eggs were candled on the 24^{th} day of incubation to identify infertile eggs and dead-in-germ. Only fertile eggs were transferred to the hatcher. Hatching was completed on the 28^{th} day and the number of the hatched keets were recorded and classified either as viable or non-viable. Healthy, normal sized keets were considered viable, while undersized, poorly feathered, lame, open-naveled and blind keets were regarded as non-viable. Viable keets were sold out, while the latter were culled. On the 29^{th} day incubation period, all un-hatched eggs were broken open to identify infertile eggs and embryonic deaths.

Data Collection and Analysis: Data obtained from the breeding and hatchery unit records on incubated Guinea fowl eggs from 2011 – 2018 were (i) fertility (%) = (total number of keets hatched + total embryonic mortality) × 100/total eggs set, (ii) total hatchability (%) = (total number of keets hatched) × 100/total number of eggs set, (iii) fertile hatchability (%) = (total number of keets hatched) × 100/(total number of keets hatched + total embryonic mortality), (iv) dead in shell (%) = (total number of dead in shell) × 100/total number of eggs set, (v) viable keet (%) = (total number of viable keets × 100/total number of fertile eggs set and non-viable keets (%) = (total number of non- viable keets × 100/total number of fertile eggs set. Data were analyzed using Graph Pad Prism version 5.00 for Windows. The differences among means were compared using a one-way analysis of variance (ANOVA) and significant means separated using Duncan multiple range test at 99 % confidence level. The means ± standard errors of means were presented in table.

RESULTS

The reproductive performance of breeder Guinea fowls reared at the Akate farms over the period 2011 – 2018 are presented in Table 1. The overall (%) fertility (F), total hatchability (TH), fertile hatchability (FH), embryonic mortality (DS), viable keets (VK) and non-viable keets (NVK), were 50.7 ± 13.0, 30.5 ± 14.0, 50.4 ± 15.0, 22.0 ± 10.0, 91.7 ± 5.4 and 8.3 ± 6.3 respectively. During the study period, reproductive performance was lowest in 2012 and highest in 2016. There was significant difference between the year of production and F, TH, FH, DS, VK and NVK rates at 99 % confidence level. F and TH (%) were highest in 2016 with 68.0 ± 11.0 and 42.0 ± 11.0 respectively and lowest in 2012 with values of 31.0 ± 21.0 and 16.0 ± 9.7. FH was highest (77.0 ±21.0) in 2018 and lowest (45.0 ±19.0) in 2013. The VK rate was highest (99.0 ± 0.3) in 2016 and lowest (57.0 ± 26.0) in 2011, while NVK was highest (43.0 ± 24.0) in 2011 and lowest (1.0 ± 0.3) in 2016. The DS values (%) were similar during the study period. However, a maximum value of 31.0 ± 18.0 was recorded in 2013 and a minimum value of 15.0 ± 13.0 in 2012.

The monthly trend of fertility, hatchability and embryonic mortality was investigated for the years 2017 and 2018 respectively (Figures 1 and 2). Fertility and hatchability increased gradually from February and peaked in March or April. On the other hand, embryonic mortality was fairly constant from February to August. In 2017, percentage fertility was highest (68.1) in April and lowest (40.4) in February, while in 2018, it was highest (59) in August and lowest (32.8) in May. Fertility rates in 2018 were generally lower than in 2017. Percentage fertile hatchability had maximum value of 76.6 in April, 2017 and a minimum value of 55.9 in February and August, 2017. Fertile hatchability rates were comparatively higher in 2018 than the previous year, with the highest (99.8) in May and lowest (36) in February. In 2017, percentage embryonic mortality was highest (22.3) in August and lowest (13.4) in March. On the whole, percentage embryonic mortality in 2018 was higher than the previous year and ranged from 18.1 – 38.2.

DISCUSSION

This study described the reproductive performance of breeder Guinea fowls reared intensively in Ghana for the production of day old keets. The yearly fertility rate ranged from 40.00 ± 14.00 % in 2010 to 68.00 ± 11.00 % in 2016. These findings were within the same range of 58.46 % reported by Yamak (2015) and of 49.00 % to 58.00 % reported by Ayorinde *et al.* (1989). The fertility rate was lower than 80.00 – 97.50 % reported by some researchers (Bernacki *et al*., 2013; Khairunnesa *et al*., 2016; Dzungwe *et al*., 2018). The lower fertility rate in this study was probably due to the high mating ratio of 10 females to one male guinea cock, practiced in this farm. According to Premavalli *et al.* (2013), a mating ratio of 1:4 and 1:5 is optimum for Guinea fowl birds reared under intensive system of management. On the other hand, fertile hatchability rates were higher than 50.00 % reported on a university farm in Umudike, Nigeria (Odukwe and Onunkwo, 2016).

The fertile hatchability rate of Guinea fowl's eggs in this study were similar to 69.00 % and 66.0 % reported by Konlan *et al*. (2011) in the dry season at Nyankpala, in the Tolon-Kumbungu District, Ghana, 68.0 % reported by Karbo *et al.* (2002) in Bawku East District, Northern Ghana and 68.57 – 75.57 % in a tropical rain forest in Nigeria (Ebegbulem *et al*., 2017). On the contrary, hatchability was lower than 88.0 % (Saina *et al*., 2005) and 91.40 % (Dzungwe *et al*., 2018). This difference in hatchability rates may be due to poor storage and handling of eggs before incubation and the efficiency of incubator management during the setting and hatching processes.

The dead in shell rate were similar to the 16.40 – 25.30 % reported by Kyere *et al*. (2017) in Ashanti Mampong. However, it was higher than 8.7 % reported by Dzungwe *et al.* (2018) and 15.0 % by Khairunnesa *et al*. (2016). The differences may be due to poor management of the processes of egg fumigation and processing before incubation.

Table 1: Reproductive performance of Guinea fowls from 2011 – 2018 in an intensively managed farm in Ashanti Region of Ghana

YEAR	EGGS SET	F (%)	TH (%)	FH (%)	DS (%)	VK (%)	NVK (%)
2011	933.0 ± 560.0^{a}	40.0 ± 14.0^{a}	18.0 ± 11.0^{b}	48.0 ± 29.0^{a}	22.0 ± 16.0^{c}	57.0 ± 26.0^{a}	43.0 ± 24.0^{d}
2012	2,831.0 ± 1,151.0^{b}	31.0 ± 21.0^{a}	16.0 ± 9.7^{a}	56.0 ± 12.0^{b}	15.0 ± 13.0^{a}	89.0 ± 6.7^{b}	10.8 ± 6.7^{c}
2013	6,925.0 ± 2,389.0^{c}	57.0 ± 10.0^{c}	25.0 ± 10.0^{c}	45.0 ± 19.0^{a}	31.0 ± 18.0^{e}	97.6 ± 2.4^{c}	2.4 ± 2.4^{b}
2014	10,280.0 ± 6,100.0^{d}	51.0 ± 15.0^{c}	33.0 ± 11.0^{d}	65.0 ± 10.0^{d}	18.0 ± 7.0^{b}	97.3 ± 3.0^{c}	2.7 ± 3.0^{b}
2015	8,001.0 ± 4,445.0^{c}	58.0 ± 14.0^{c}	38.0 ± 15.0^{e}	65.0 ± 10.0^{d}	21.0 ± 7.6^{c}	97.7 ± 1.8^{c}	2.3 ± 11.8^{b}
2016	10,594.0 ± 4,567.0^{d}	68.0 ± 11.0^{c}	42.0 ± 8.1^{e}	62.0 ± 6.7^{c}	26.0 ± 6.7^{d}	99.0 ± 0.3^{c}	1.0 ± 0.3^{a}
2017	6,115.0 ± 1,129.0^{c}	56.0 ± 10.0^{c}	37.0 ± 10.0^{e}	65.0 ± 9.0^{d}	19.0 ± 5.0^{b}	98.2 ± 1.1^{c}	1.8 ± 1.1^{b}
2018	9,471.0 ± 1,631.0^{c}	45.0 ± 8.3^{b}	35.0 ± 11.0^{d}	77.0 ± 21.0^{e}	25.0 ± 6.7^{d}	97.5 ± 2.3^{c}	2.5 ± 2.3^{b}
Overall Mean	6,893.8 ± 1,631.0	50.7 ± 13.0	30.5 ± 14.0	50.4 ± 15.0	22.0 ± 10.0	91.7 ± 5.4	8.3 ± 6.3

F = fertility, TH = total hatchability, FH = fertile hatchability, DS = dead in shell, VK = viable keet, NK = non-viable keet, Means with different superscripts in the same column are statistically significantly different at 99 % confidence level

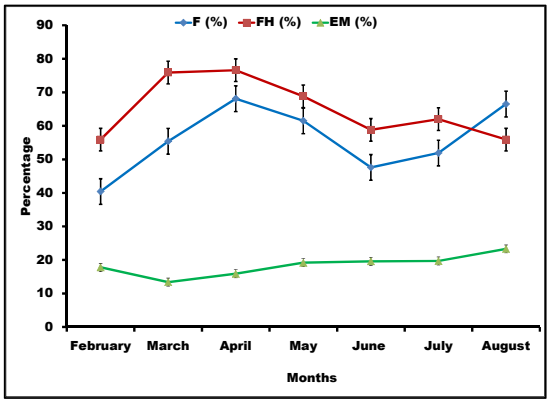

Figure 1: Fertility, fertile hatchability and embryonic mortality trends of Guinea fowls for 2017 in an intensively managed farm in Ashanti Region of Ghana

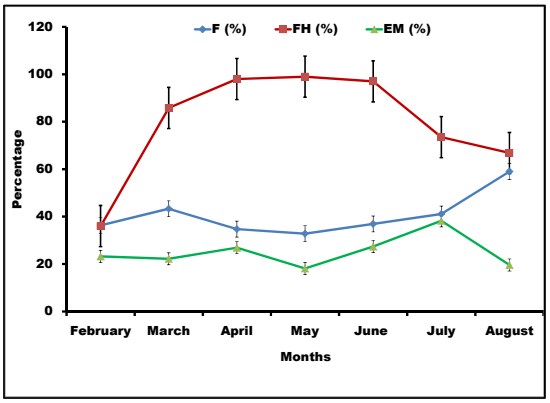

Figure 2: Fertility, fertile hatchability and embryonic mortality trends of Guinea fowls for 2018 in an intensively managed farm in Ashanti Region of Ghana

Fertility and hatchability increased gradually from February and peaked in March or April. This period coincided with the onset of the rainy season and increasing photoperiod. Egg laying reduced drastically or ceased in November. These findings were in agreement with the report of Houndonougbo *et al.* (2017) that Guinea fowls are seasonal breeders and begin to reproduce with the onset of the rainy season and cease when adverse conditions set in.

The Seasonal reproductive behavior in Guinea fowls limits the availability of fertile eggs for incubation and keets for rearing throughout the year (Kolan *et al.*, 2011).

Embryonic mortality did not follow any particular trend during 2017 and 2018. However, variations occurred in both years. In 2017, embryonic mortality was lower than 20 %, while it was higher than in 2018, with the highest of 40 % in July.

Conclusion: Fertility and Fertility hatchability were low on this farm, while embryonic mortality was high. It is recommended to change the mating ratio to one male guinea fowl to four females and improve upon hygiene in egg procession, fumigation and incubator management**.**

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